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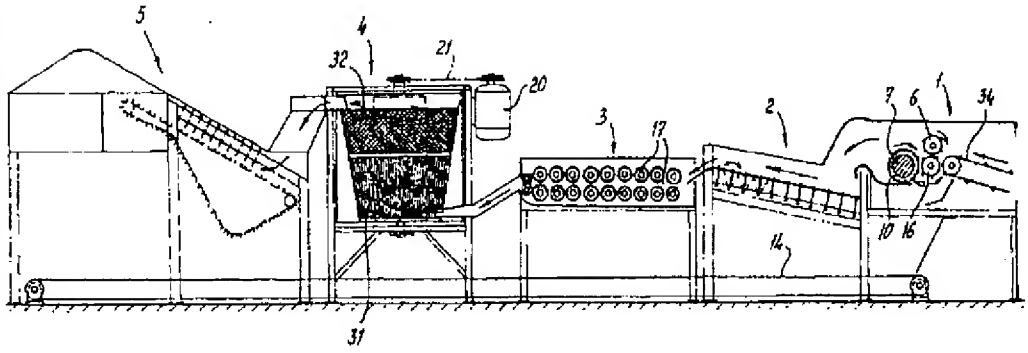
(54) **Apparatus for processing flax straw, and also flax straw opener and drum therefor.**

(57) An apparatus for processing flax straw in which the high-quality bast fibre is separated from wood parts and bast parts is provided with one or more beating drums for processing the flax straw. In order to be able to meet the requirements which are imposed in processing tangled flax straw such as orginates from combines, to increase the capacity, to take account of variations in the composition of the flax straw and to decrease the investments, the apparatus comprises a flax straw opener coupled in upstream of the beating drums, which flax straw opener comprising a toothed ripping roller with a number of teeth rings and one or more counterknife beams interacting therewith and provided with knives which project between the teeth rings in a manner such that each teeth ring interacts with a pair of knives. The processed flax straw material is fed to a drum comprising a fixed, rotationally symmetrical shell provided with grate openings and also a rotatable interior mechanism situated therein and having scutching knives.

fig-1



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Apparatus for processing flax strain, and also flax straw opener and drum therefor

The present invention relates to an apparatus for processing flax straw in which the high-quality bast fibre is separated from wood parts and bast parts, which apparatus is provided with one or more beating drums for processing the flax straw.

These known apparatuses have already been developed some time ago and do not meet the requirements which are at present imposed in processing tangled flax straw such as originates, for example, from combines.

Furthermore, said known apparatuses have only a low capacity and they yield a low-quality fibre material, i.e. with a high content of contaminants. The known apparatuses can also virtually not be adjusted, with the result that it is not possible to take account of variations in the composition of the flax straw. An important disadvantage is, finally, that the operating costs of the known apparatuses are high in view of the high investments, the peripheral equipment required and the labour-intensive nature which are associated therewith.

The object of the invention is therefore to provide an apparatus of the abovementioned type which lacks these disadvantages and which is suitable, in particular, for processing tangled flax straw into a high-quality fibre material. This object is achieved in the first instance in that a flax straw opener is coupled in upstream of the beating drum(s), which flax straw opener comprises a toothed ripping roller having a number of teeth rings and one or more counterknife beams interacting therewith and provided with knives which project between the teeth rings in a manner such that each teeth ring interacts with a pair of knives.

Said flax straw opener processes the tangled straw package supplied in a manner such that it is intensively pulled open and is uniformly separated. In particular, the ripping and cutting movements provided by the interaction of the teeth and the knife beams play an important role in this process. A further effect of the flax straw opener is the shortening of the fibre material. Finally, a large part of the wooden tubing is separated; the loose chaffs thereby formed may already possibly be separated then in a pre-cleaning phase. Depending on the extent to which the flax straw has to be pulled open and its coarseness, the rotary speed of the ripping roller can be varied, preferably between 500 and 1,500 revolutions per minute.

In connection with the supplying and possible slowing down of the flax straw in the feed to the ripping roller, a positively driven feed roller pair is coupled in upstream thereof.

The flax straw material processed in this manner is then fed to a drum comprising a fixed, rotationally symmetrical shell provided with grate openings and also a rotatable interior mechanism situated therein and having scutching knives. In said drum, the material is further pulled open and scutched in order to separate the last wooden components from the bast fibre. The chaffs and the dust are as far as possible removed through the grate openings in the shell under the influence of the centrifugal force and the atmospheric pressure differences generated during rotation.

Preferably, an embodiment is chosen in which the centre line of the drum is vertical, the feed for the flax straw to be processed is situated at the bottom and the discharge of the processed flax straw is situated at the top of the shell, and the shell of the drum extends in a widening manner from the bottom to the top. The conical shape promotes the conveyor action of the drum in a favourable sense. If, at the same time, the scutching knives are situated at an angle in a manner such that they provide an upwardly directed conveyor action during rotation, the conveyor and separating action of the drum can be improved still further.

To promote the removal action of chaffs and dust through the shell, the internal mechanism is provided with vanes which extend along essentially radial planes to the shell. If, at the same time, the vanes extend at an angle at their radially outermost edge to match the shell and are provided at said edge with a row of carding teeth and the inside of the shell is also provided with at least one row of carding teeth offset by a half tooth pitch and extending in a plane through the centre line of the drum, the material can be mechanically carded, in addition, by the mutual interaction of the rows of carding teeth moving closely over one another.

The rotary speed of the drum is preferably chosen between 150 and 500 revolutions per minute.

At the uppermost end of the internal mechanism, a ring of beating knives is provided as a ventilator for removing the processed fibre material via the discharge.

Furthermore, provision can be made that, between the flax straw opener and the drum, a shaking apparatus is coupled in for removing loose short wood components and also a breaking apparatus for breaking longer wood components in sequence, and after the drum, a second shaking apparatus is provided for finally cleaning the processed flax straw. Such a complete processing line offers the possibility of processing the total straw crop in tangled form. Despite the fact that the line is technically compact, it is nevertheless suitable

for bulk processing. In addition, the possibility is provided for responding to variations in the agricultural product, for example by adjusting the rotational speeds of the flax straw opener and the drum or alternatively by adjusting the mutual spacing of the carding teeth.

The invention also relates to a flax straw opener for the apparatus described above. In particular, it is so constructed that the teeth on the ripping roller have a comparatively small pitch and those on the feed rollers have a comparatively large pitch so that the circumferential circles defined by their teeth tips overlap one another with an offset in the axial direction.

Finally, the invention relates to a drum for the apparatus described above in which, in particular, three pairs of scutching knives are provided starting from the bottom and each pair has in sequence a ring of scutching knives mounted directly on the cylinder and also a ring of scutching knives mounted on an outermost disc edge.

The invention will be explained further hereinafter with reference to an exemplary embodiment shown in the figures.

Figure 1 shows a complete flax processing line in side elevation.

Figure 2 shows the flax straw opener according to the invention, used in the processing line, in perspective.

Figure 3 shows a plan view of the flax straw opener according to Figure 2.

Figure 4 shows the drum according to the invention used in the processing line according to Figure 1.

The processing line depicted in Figure 1 comprises, in sequence in the direction in which the flax straw to be processed passes through it, a flax straw opener according to the invention 1, a shaking apparatus 2, a series of fluted rollers 3 for breaking the flax straw, a drum 4 according to the invention, and, finally, a shaking apparatus 5 over which the flax fibres obtained are removed.

As is also depicted in Figure 2, the bundles of tangled flax straw are fed via conveyor belt 34 to a pair of rollers 6 and 16 provided with teeth, via which rollers the flax straw is fed to ripping roller 7. The uppermost roller 6 of the roller pair is suspended, so as to move in the vertical direction, on a frame 8 which is partially shown in Figure 2 and which is pressed by means of a spring 9 in the direction of the lowermost roller 6. As a result of this, the nip between the rollers 6 and 16 can adjust itself to the thickness of the bundles of flax straw. Furthermore, the uppermost roller 6, like the lowermost roller 16, is individually positively driven in a manner not shown, while the ripping roller 7 is also driven. The rotary speed of the uppermost roller 6, and therefore of the lowermost roller 16, is lower than that of the ripping roller 7, in a manner such that, if the flax straw is gripped by the teeth rings 10 on the ripping roller 7, the teeth 11 exert a braking action and the teeth 15 on the lowermost roller 16 a feeding action, in which process the flax straw is uniformly opened and ripped apart. Situated at the bottom of the ripping roller 7 is furthermore a knife beam 12 on which knives 13 are mounted at a clearance angle of 10°. At the same time, each teeth ring is surrounded on either side by a pair of knives 13 which remove the flax straw entrained by the teeth 10 from the roller and break it further in doing so. In this process a certain separation occurs of the flax straw fed in into, on the one hand, fibre components and, on the other hand, wood and bast components.

In the plan view of the flax straw opener shown in Figure 3 it can be seen that the teeth 11 are mounted on the uppermost roller 6 with an axial offset with respect to the matching teeth 15 on the lower roller 16. It can furthermore be seen that the teeth 10 on the ripping roller 7 extend to inbetween the teeth 11 and 15.

From the flax straw opener 1, the processed flax straw material is fed to the shaking apparatus 2 where a portion of the finer waste is removed by shaking. This then falls onto the belt 14 and is removed therewith.

From the shaking apparatus 2, the material enters between the series of fluted rollers 17 where the larger flax straw components are broken. This process is known per se.

Then the material is fed to the drum 4 which is shown in more detail in Figure 4. The drum comprises a conical shell 18 in which an internal mechanism 19 is rotatably mounted. The internal mechanism is driven by means of a motor 20 and a belt transmission 21.

The flax straw material is fed via the lowermost feed opening 33 to the interior of the shell 18. During the rotation of the internal mechanism 19, the flax straw is then scutched by the scutching knives 23 and 24 mounted on the central shaft 22 of the internal mechanism 19. Said scutching knives are arranged at an angle in the manner of turbine blades in a manner such that an upwardly directed conveyor action is generated. In this connection, the scutching knives 23 are mounted directly on the shaft 22, while the scutching knives 24 are mounted on a disc 25 extending radially with respect to the shaft 22. On said disc 25 and the shaft 22 vanes 26 are furthermore provided which have the object, during the rotation of the internal mechanism 19, of forcing the waste material outwards through the grate openings in the shell 18 under the influence of the atmospheric pressure differences thereby generated.

As depicted, the drum according to the inven-

tion has three sets of scutching knives 23 and 24 with a disc 25 arranged above one another. In conjunction with the conical shape of the shell 18, all these scutching knives 23, 24 ensure an upward conveyor flow. Finally, at the top of the drum, the material is removed by means of the beating knives 26, also arranged at an angle, through the discharge opening 27 situated at the top.

As depicted, further vanes 28 are mounted between the centremost and uppermost disc 25, which vanes extend by means of their radially outermost edge to a point near the inside circumference of the shell 18 and are provided at that point with a row of carding teeth 29. Mounted on the internal circumference of the shell 18 are three matchingly constructed rows of carding teeth 30 which are offset by a half tooth pitch. These can be adjusted towards the shaft and are arranged in a somewhat tapering manner. When the material is now fed up through the drum from the lowermost feed 33 to the uppermost discharge 27, the fibres are mechanically carded by the mutually interacting rows of carding teeth 29 and 30. Such rows of carding teeth may also be situated on the vanes 26 and the wall components, situated opposite, of the shell 18. At the same time, the material is forced towards the shell 18 during this conveyor movement under the influence of the centrifugal force and atmospheric pressure differences generated during rotation of the shaft 22 in a manner such that contaminants emerge outwards through the grate openings in the shell 18. In this connection, the grate openings are formed in the lowermost part of the shell 18 between grate rods 31 extending along lines describing a cone and in the uppermost portion by constructing the wall in so-called pressed-through gauze 32 with the smooth side facing inwards. This removed material also then comes to rest on the belt 14 which also extends beneath the drum.

From the discharge 27, the fibre material now obtained is conveyed over the shaking apparatus 5 where contaminants still present may be further removed.

Claims

1. Apparatus for processing flax straw in which the high-quality bast fibre is separated from wood components and bast components, which apparatus is provided with one or more beating drums for opening the flax straw, characterized in that a flax straw opener is coupled in upstream of the beating drums, which flax straw opener comprises a toothed ripping roller having a number of teeth rings and one or more counterknife beams interacting therewith and provided with knives which project between the teeth rings in a manner such that each teeth ring interacts with a pair of knives.

2. Apparatus according to Claim 1, wherein the knives make a clearance angle of approximately 10° with respect to the lateral surface of the ripping roller.

3. Apparatus according to one of the preceding claims, wherein a toothed, positively driven feed roller pair is coupled in upstream of the ripping roller.

4. Apparatus according to Claim 3, wherein the uppermost roller of the feed roller pair is suspended in a pivotable spring-loaded bracket which is pressed towards the lowermost roller in a manner such that the nip between the two rollers is variable.

5. Apparatus according to one of the preceding claims, wherein the beating drum comprises a fixed, rotationally symmetrical shell provided with grate openings and also a rotatable internal mechanism situated therein and having scutching knives.

6. Apparatus according to Claim 5, wherein the centre line of the drum is vertical, the feed for the flax straw to be processed is situated at the bottom and the discharge of the processed flax straw is situated at the top of the shell.

7. Apparatus according to Claim 6, wherein the shell of the drum extends in a widening manner from the bottom to the top.

8. Apparatus according to Claim 6 or 7, wherein the scutching knives are arranged at an angle in a manner such that they provide an upwardly directed conveyor action during rotation of the rotatable internal mechanism.

9. Apparatus according to Claim 6, 7 or 8, wherein the internal mechanism is provided with vanes extending along essentially radial planes to the shell.

10. Apparatus according to Claim 9, wherein the vanes extend at an angle at their radially outermost edge to match the shell and are provided at said edge with a row of carding teeth and the inside of the shell is also provided with at least one row of carding teeth offset by a half tooth pitch and extending in a plane through the drum centre line.

11. Apparatus according to Claim 10, wherein the internal mechanism is provided with one or more sets of three vanes regularly distributed in the direction of rotation and the shell is provided with three matchingly distributed rows.

12. Apparatus according to Claim 10 or 11, wherein the carding teeth rows on the shell are radially adjustable.

13. Apparatus according to one of Claims 5 to 12 inclusively, wherein the internal mechanism is an essentially cylindrical shaft provided with external concentric discs extending radially at the top to some distance from the shell.

14. Apparatus according to Claim 13, wherein certain scutching knives are mounted on the radially outermost edge of the discs and others directly on the shaft.

15. Apparatus according to one of Claims 5 to 14 inclusively, wherein a ring of beating knives is provided at the uppermost end of the internal mechanism as a ventilator for removing the processed flax straw via the discharge.

16. Apparatus according to one of the preceding claims, wherein in sequence between the flax straw opener and the drum, a shaking apparatus is coupled in for removing loose short wood components and also a breaking apparatus for breaking longer wood components.

17. Apparatus according to Claim 16, wherein a second shaking apparatus is provided downstream of the drum for finally cleaning the processed flax straw.

18. Apparatus according to one of the preceding claims, wherein the rotary speed of the ripping roller is variable between 500 and 1,500 revolutions per minute.

19. Apparatus according to one of the preceding claims, wherein the rotary speed of the drum is variable between 150 and 500 revolutions per minute.

20. Flax straw opener for an apparatus according to one of the preceding claims.

21. Flax straw opener according to Claim 20, wherein the teeth on the ripping roller have a comparatively small pitch and those on the feed rollers have a comparatively large pitch, the circumferential circles defined by their teeth tips overlapping one another with an offset in the axial direction.

22. Drum for an apparatus according to one of Claims 5 to 19 inclusively.

23. Drum for an apparatus according to Claim 14, wherein three pairs of scutching knives are provided starting from the bottom and each pair has in sequence a ring of scutching knives mounted directly on the cylinder and also a ring of scutching knives mounted on an outermost disc edge.

24. Drum according to Claim 23, wherein the lowermost portion of the shell comprises rods extending according to lines describing a cone and the uppermost portion comprises gauze pressed-through on one side to the outside.

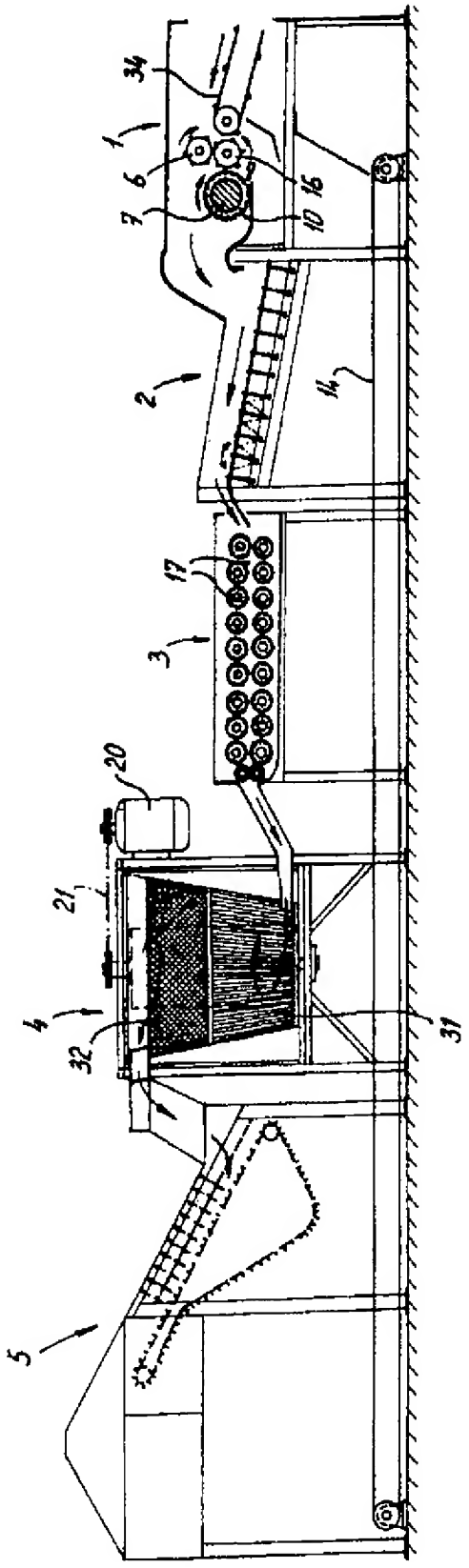
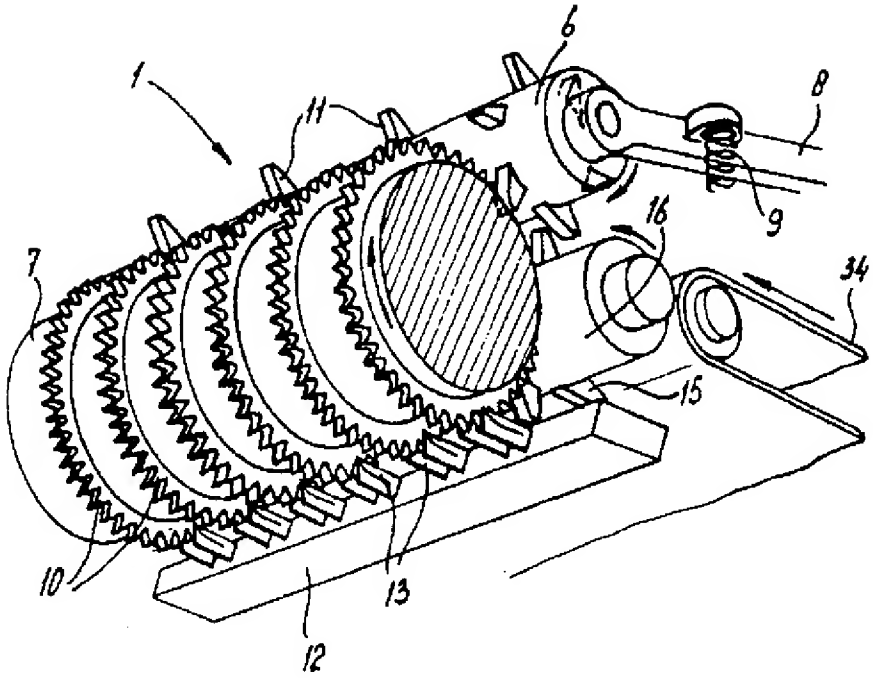


Fig - 1

fig-2



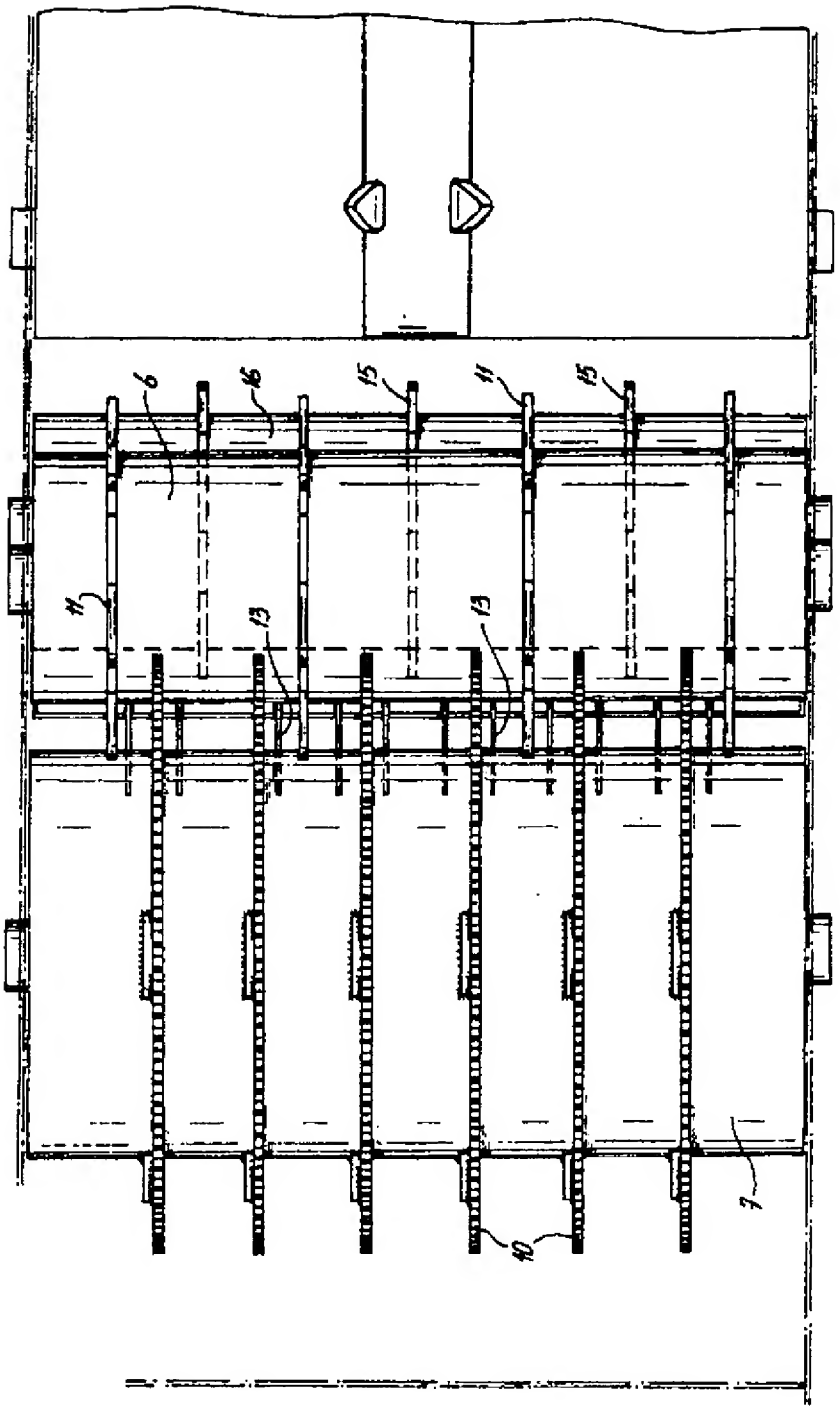
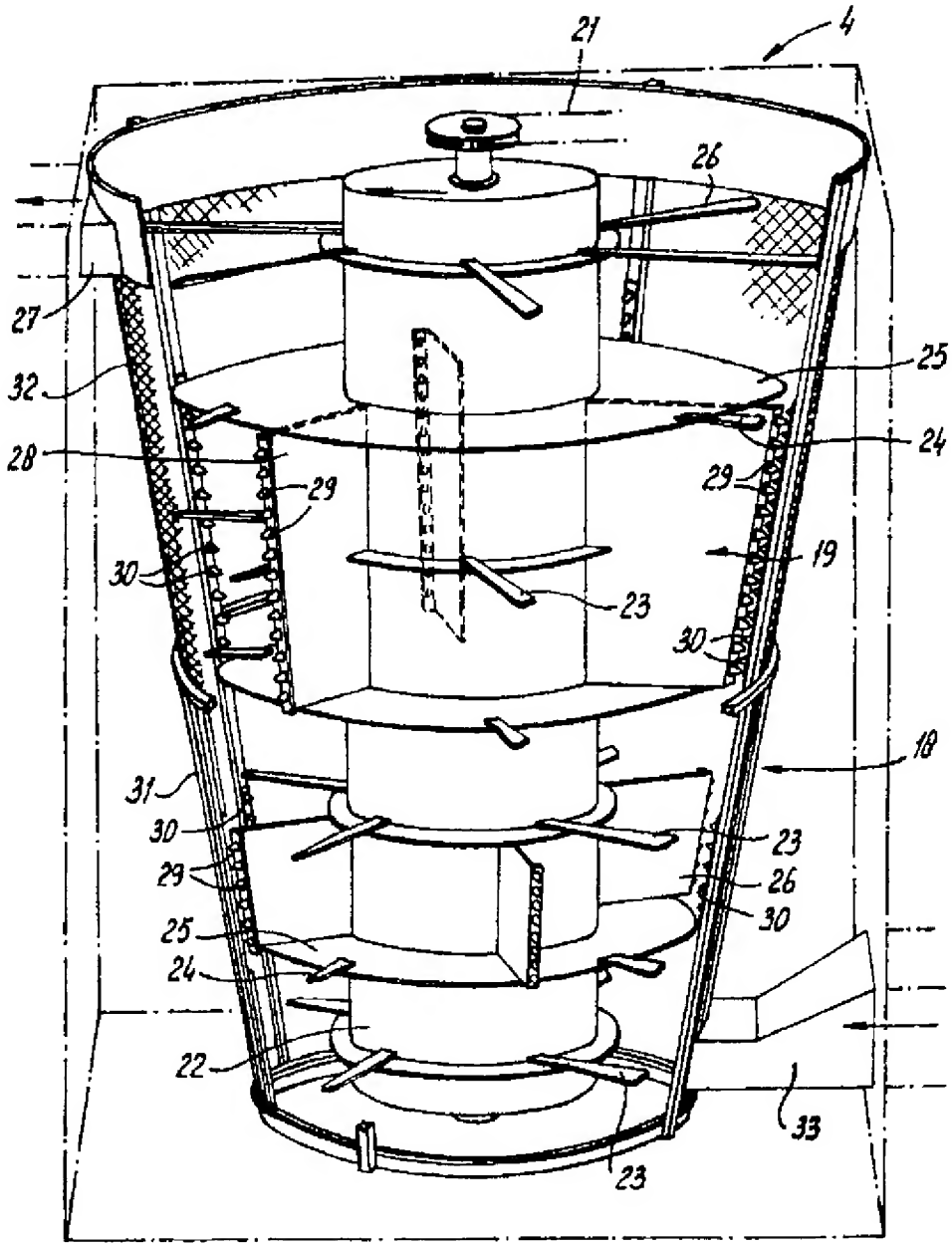


Fig-3

Fig - 4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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 1168

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US-A-2348813 (HILARION G. MENARES) * page 1, right-hand column - page 2, left-hand column; figures 2, 3 *	1	D01B1/14 D01B1/24 D01B1/28
A		3, 16, 20	
Y	US-A-2197683 (BURKARDT,A.F.) * page 6, line 42 - page 7, line 65; figures 1, 2, 6, 8, 9, 12 *	1	
A		3, 16	
A	US-A-4202078 (MALINAK,F.J.) * the whole document *	1, 5, 6, 9, 13, 23	
A	US-A-3334386 (FREEMAN,L.)		
A	DE-C-454385 (GMINDER,E.)		
A	FR-A-889527 (VANSTEENKISTE,G.)		
A	NL-A-46012 (WERKSPOOR N.V. ET AL)		TECHNICAL FIELDS SEARCHED (Int. Cl.5) D01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07 SEPTEMBER 1990	MUNZER E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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